

# *Gaming Through Dyslexia*

An interactive digital application that is a learning tool for students under the age of ten that have Dyslexia.

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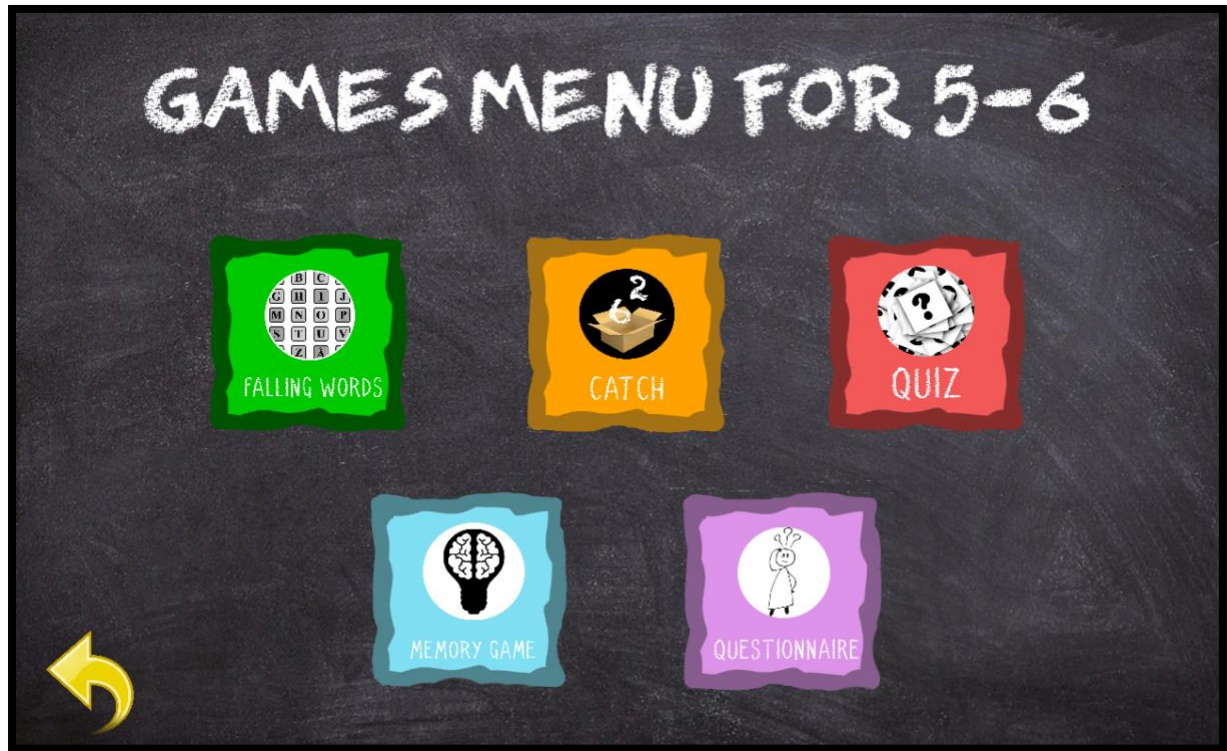


Fig. 1 – Games menu screen on application

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*Mikaela Russell*

## *Attestation of authorship*

"I hereby declare that that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the Acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning."

A handwritten signature in black ink, appearing to be 'M. R. ...' with a stylized flourish at the end.

# *Acknowledgments*

I want to thank the Digital Design Department at AUT and the excellent lecturers for supporting and encouraging me to go just that little bit further during the five years of my undergraduate and postgraduate studies. I also want to acknowledge my undergraduate class of Digital Design 2017, who became some of my best friends and are now family to me.

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Also a mention to EA Games, where the passion began for gaming, specifically The Sims, which started my enthusiasm for gaming and technology when I was a little girl.

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# *Abstract and Research Question*

This research thesis approaches the research question of "How can we use interactive digital applications as a learning tool to improve skills and abilities for students under the age of ten that are diagnosed with Dyslexia?" Dyslexia is a common subject that is talked about amongst the academic community, specifically on what they can do to help and support students who have Dyslexia in the classroom. There is a lack of learning tools in the education system for dyslexic students to use to help them with their academic work. Having Dyslexia myself, I have always been passionate about wanting to create a learning tool to aid students who need an extra hand with learning especially at the significant ages of five to ten where most of your essential learning is done.

I created a digital interactive visual application that can be used as a learning tool in and outside the classroom to help assist students who have Dyslexia and give them another form of learning instead of a textbook method. Using serious games like the ones I have created as educators will push the student's skills in the direction they need to be in order to advance their results to continue to help with their schooling. Throughout this research, I have found positive results showing that using my interactive learning games it has proven to be a quicker way for a student that has Dyslexia to recall knowledge from that particular game/subject to apply into their work at school and use as a different form of learning.

This research opens up a topic of a unique form of learning that could be placed into the school curriculum. This exploration is a step in the right direction of what I believe to be the future of learning, especially for those who have Dyslexia and need the extra helping hand when it comes to education.

# *Introduction*

This thesis explores the benefits and challenges between bringing serious gaming into the classroom and how it can establish a connection with students who have Dyslexia and need an extra learning tool to help with advancing their education. Dyslexia is a learning disability that involves the difficulty of learning to read and write as well as interpret words, letters and in some cases numbers, but does not affect the overall general intelligence of a person. As someone that has Dyslexia, I struggled at an early age with the typical method of learning at school with textbooks, whilst learning interactively and visually came easy to me, and I picked up on skills a lot quicker.

This exegesis is formatted into four sections which go into depth about gaming through Dyslexia. The first section discusses the theories and articles that relate to my research. This includes texts by Kurt Squire (2005), Sioned Exley (2004), Miquel Sicart (2011) and Jane M Healy (1999) who all explore the different arguments and challenges surrounding Dyslexia and gaming in the education sector. The second section explains the different methodologies that were used to produce the results in the research, such as action research and critical self-reflection. The third and fourth sections of the exegesis go into detail about the findings, discussion and a final conclusion of the research, which includes a detailed response to the gaming application.

The importance of this research is to fill in the gap where there needs to be different methods of learning tools to aid students that have Dyslexia and answer the research question of “How can we use interactive digital applications as a learning tool to improve skills and abilities for students under the age of ten that are diagnosed with Dyslexia?”. Throughout this exegesis, I have included my own personal accounts with Dyslexia which brings in my reasoning as to why I decided to research this topic and why it is needed not only for my own reasons but for others who are in a similar situation and have the opportunity to have this learning tool in place.



# *Literature Review*

## *Introduction*

This section of the thesis, the researcher will review the relevant literature related to serious gaming and Dyslexia. It also touches on how gaming can be introduced into the classroom and how we can use interactive games to give to children with Dyslexia as a learning tool. Dyslexia is discussed a lot throughout education institutions, and there have been many studies, for example, the ones The researcher will discuss in this review on how gaming applications can be used to benefit and help by being a visual and interactive platform for children with Dyslexia and this review will explore that and how it relates to the research.

## *Serious Gaming*

Although there are several studies about playing games for Dyslexia, there does not seem to be any literature on Serious Games and Dyslexia. Articles that relate to my research are “Changing the Game: What Happens When Video Games Enter the Classroom?” by Kurt Squire (2005) and “The effectiveness of teaching strategies for students with dyslexia based on their preferred learning styles” by Sioned Exley (2004), are talking about how we must think about different learning styles to help students that have Dyslexia and what happens when we bring those learning styles, for example, gaming applications in to the classroom for the students to use. I will also explore the opposite end with articles “The Ethics of Computer Games” by Miquel Sicart (2011) and “Failure to Connect: How computers affect our children’s minds for better and for worse” by Jane M Healy (1999), which talk about the downside of using computer applications and gaming with children and how they can impact their brain for better or for worse.

Kurt Squire (2005) asks the question of whether educators can use games to support learning in the classroom and how we can use games most effectively as educational tools. He explains that the application that we use would need to fall into place with the curriculum that already stands at schools and that bringing in something new could cause issues and also face rejection in the school environment instead of it excelling. He states that “Those unfamiliar with contemporary video games are shocked by their complexity and difficulty”. I understand what Squire (2005) is trying to say, however, In this day and age it is different due to the fact that most of the generation that is under the age of ten

in my research has been raised on electronics and applications that are used in their everyday lives. Giving them an app to use in the classroom may provide them with something to relate too and not feel unfamiliar. Since it is something that they know and are already using games outside of school, this would then push their learning since they know how to work their way around an application and want too rather than a textbook. This brings me to the preferred teaching strategies for students in the classroom and what parents and the education ministry believes is right for students to enhance their learning, for example, on the government website for learning in New Zealand it has a set standard for what your child will learn and how in primary school. In the article “The effectiveness of teaching strategies for students with dyslexia based on their preferred learning styles”, Exley (2004) talks about if the learning styles that are set in place for students to learn are effective and how we will need to change those learning styles as the world changes around us for example with technology. Just because we are conformed to something that does not mean that it is more effective than what we can change it to using things that children are used to like gaming applications and do not find it challenging to pick up and catch on to. Exley’s (2004) research states that a study was performed on children with Dyslexia and five out seven of those students felt as though they improved their skills and learned more from using a preferred learning style for dyslexic students as well as “improved feelings about and attitudes towards their school work” (Exley, 2004). This research states that when students with Dyslexia are put into an environment that has the option of learning a different way that is customised to their needs with learning with Dyslexia, They are more likely to excel and effects their overall mood and feelings towards education and learning. My research question states that I want to “improve the skills and abilities” of a student with Dyslexia and show that giving them a gaming application that I have created using the skills that they already have to learn what they will need for their education.

### *Ethics of Computer Games with Children*

“The Ethics of Computer Games” by Miquel Sicart (2011) talks about the ethics of computer games and what it teaches children about morals and everyday situations. This article relates with the preferred type of learning that we are using in our education system and that majority may find it hard to accept the presence of a new way of doing things and may judge it for being something that it's not. Instead of having an open mind to an application that would benefit students with Dyslexia, some people make up their minds before they can see the benefits that it can have on the students.

This also depends on a particular type of game that we give to the students, for example, *Super Mario* or *Pac Man*, but in this case, it would be a Serious Game, not just a game for fun. When people hear video games or computer games, they tend to think of adjectives like laziness, unmotivated and antisocial. This can have an impact on people's opinions on letting games into the classroom before actually getting to know the story behind the game and the value it can have on a student that wants to learn in a different way to the standard protocol. In Jane M Healy's piece called "Failure to Connect: How computers affect our children's minds for better and worse" (2009) it corresponds with Miguel's article about The Ethics of computer games. Healy (2009) talks about both sides of the picture, one being "computers, used incorrectly, may do more harm than good" and the other being you can learn from technology and we should be using it for educational purposes. Healy (2009) keeps an anonymous response to how she feels about technology throughout her piece but does seem to be in favour of the upsides of technology helping children learn because of her stating that technology can benefit our children and we should incorporate learning methods into a device that our children are going to be using anyway. Although these two articles give very valid points on both sides of the story being negatives and positives of children having technology in their lives, they do not provide an overall response for creating educational minigames as Serious Games for dyslexic learners. As well as what they think should come of it being a part of children's lives, especially in the educational department.

A big part of my research is working out what kind of games I can use to associate with certain subjects for children that have Dyslexia to use as a learning tool and whether a specific game becomes something fun for the child or working out that they are gaining knowledge from using this application. Working with essential subjects like Mathematics, English and Spelling is a must and are the main subjects of my minigames. In the article "Changing the Game: What Happens When Video Games Enter the Classroom?", Squire (2005) takes on a case study where he has two separate classrooms and gives each a specific game to help them with a subject for example in history, he used the game *Civilisation III*. Using this game in the classroom, he worked out that children were more likely to be excited about learning since they were playing rather than given a textbook or be taught through a teacher standing at the front of a classroom explaining what happened in history. Instead, they were given their own time to work through an application that gives them the knowledge of what occurs in history as well as being visual and an interactive tool for learning. Knowing that children will react more positive by being given a gaming application instead of a textbook pushes my research further to see that it is

possible to have games like these in the classroom and they can work. However, I am researching children with Dyslexia using gaming as a learning tool, not the everyday student. Bavelier, Green and Seidenberg's "Cognitive Development: Gaming Your Way Out of Dyslexia?" (Bavelier et al, 2013) relates to this research by talking about if we can train the mind of someone that has Dyslexia through gaming by helping them gain different skills and techniques, it could potentially be useful in assisting children with learning disabilities with their education. This article talks about a wide range of learning disabilities, not just Dyslexia. Bavelier, Green and Seidenberg conclude that different learning tools for students that have learning disabilities do reflect positively on their work in the long run. With my minigames being focused on specific subjects, this will narrow down how we can determine if the child is benefiting from the game or not by simply taking note of their spelling skills before using the application and then again after a couple of weeks of using the game. Although Bavelier, Green and Seidenberg's research shows positive affirmation on gaming with learning disabilities, my research and application are purely for Dyslexia because other learning disabilities have different traits that may need their own form of particular tools to assist with learning. In this article "Understanding Dyslexia" by Katherine Martinelli, Martinelli says that "Dyslexia is not a reflection of a child's intelligence — in fact, it's defined as a gap between a student's ability and achievement". She then dives into the different symptoms of Dyslexia for a child and what they need to be able to bridge that gap between the student's ability and achievement. This article reassured me that Dyslexia is not a reflection on the child's intelligence, it is merely a different way of learning, and that means there needs to be tools in place to be able to connect the student's ability with what they can achieve. Applications like my learning game can be that tool for them and can be that assistants that they need to be able to achieve anything they want to like any other students in the classroom.

# *Methodology*

## *Introduction*

In this section of the thesis, the researcher will discuss methodologies used throughout the project that assisted the work and helped generate the ideas and research used to put into the final project. The researchers question for this study is “How can we use interactive digital applications as a learning tool to improve skills and abilities for students under the age of ten that are diagnosed with Dyslexia?”

## *Action Research*

Action research has the definition of the methods that were taken to solve a problem in collaboration or as an individual. The primary process of action research is a plan, action, observe and reflect. If the action research is carried out, and the problem is not solved, it would be then to go back and try again. With the research question being “How can we use interactive digital applications as a learning tool to improve skills and abilities for students under the age of 10 that are diagnosed with Dyslexia?”, breaking up this question to execute a plan was vital. Firstly was finding literature reviews that reflected the topic of educational games and Dyslexia to be able to gather a further understanding of the research question. Examples of these literature pieces that were found are, "Educational Games: A Technique to accelerate the acquisition of reading skills of children with learning disabilities." by Charlton, Beryl, and Williams, Randy Lee, and McLaughlin, T.F (2005) and “Video Gaming, Education and Digital learning technologies.” by John Kirriemuir (2002). The next phase was to then create prototypes of minigames that had many different methods of learning and various subjects. New minigames were then created with the same topics but a different approach, for example, the minigame "Falling words". Falling words is a game where the user must type out the words before they hit the bottom of the screen, which helps with spelling words out as well as giving the user that gaming and competitive experience.



Fig. 2 – Falling words game on application

Another minigame that was created as a prototype was the game "Catch" where the player has to catch all the even numbers in the box and make sure they do not catch the odd numbers otherwise points will be deducted. When first creating this game, there were many possibilities of what the game's main objective could be, for example, catch all the adjectives was another prototype of the game. This game was where there were nouns and adjectives falling from the top of the screen, and the user would have to catch only the adjectives in the box. For the time being and for the age range using the idea of catching the even numbers from the odds was a better path to go down considering that adjectives and nouns are still tricky for a student at that age.

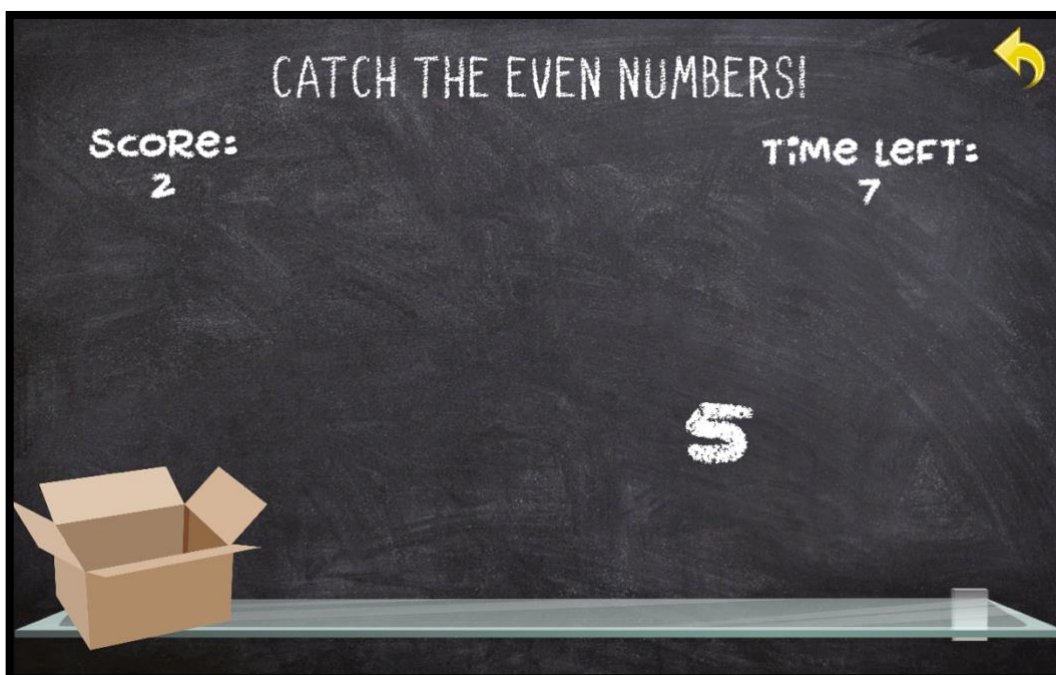


Fig. 3 – Catch game on application

Having these prototypes to use and fall back on when the idea was not working out was critical for the research and the project. Overall the game started with ten prototypes which were then narrowed down to five minigames after doing the action research method to figure out which ones were relevant and are crucial to learning skills for a child with Dyslexia.

### *Critical Self Reflection*

Having Dyslexia was a crucial part as to why I started this thesis in the first place and the experiences I have had in schooling with having Dyslexia, especially as a minor under the age of ten. Majority of basic knowledge is learnt between the ages of five and ten, for example, mathematics, reading, writing and discovering what things are. This is why it is imperative to support the students that have Dyslexia at this time which is during this a crucial part of their learning at school. When creating this project, I had the advantage of knowing what would help and what would be needed in the application because of my experiences of being left behind in the classroom. I knew what was required to give a child that has Dyslexia the right learning tool to be able to keep up and build their skills.

Having my own experiences to reflect on to know if I was on the right track with my application was a crucial part of my production process in methodologies. For example, when creating the minigame prototypes I needed to make sure that the subjects that I was targeting were correct with the age of the students that were using it. I did this by researching the curriculum for New Zealand schools at the ministry of education which shows what a student should know after each year of schooling. I also knew that when I was a child, having visual and interactive activities during subjects helped me pick up on key points in that subject that we needed to learn, for example, words or learning nouns and adjectives. When creating the minigames, I knew they needed to be a game that captured the user's attention and kept that attention span throughout the game until completion. Once the game was completed they would have been sub-consciously learning throughout the interactive experience and being able to recall the knowledge, for example, words or multiplications will be much easier since they will have that visual and interactive picture in their brain to remember. Having written words in a book was not something that I was able to learn from, and most dyslexic students struggle with this as well. I knew that visual and interactive methods had to be in place for not only the learning to be absorbed but also the experiences of having fun with an interactive game.



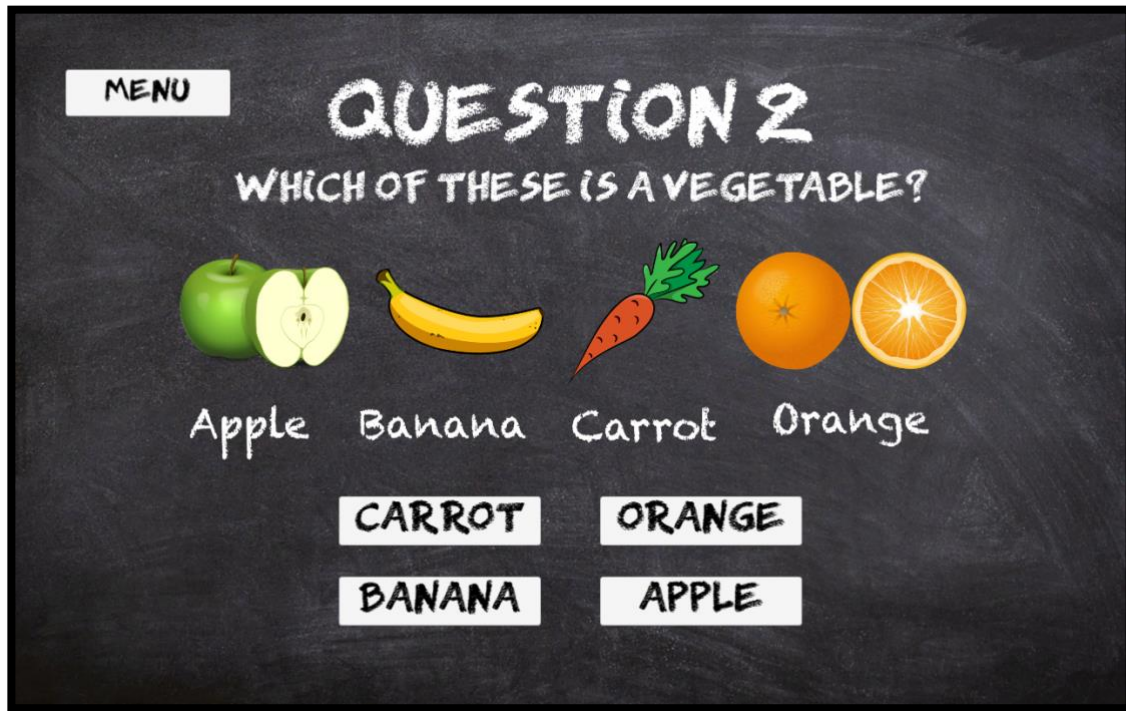


Fig. 4 – Quiz game on application

The decision to exclude a formal evaluation with end users from this project was predominantly made based on two factors. First, the target audience for these educational games are learners that have from dyslexia. According to several studies, an effective intervention has to happen at an early age (pre-school or primary school level). Obtaining ethics approval for a high risk group such as young children is virtually impossible within the scope of this degree.

Second, in order to keep the scope of this initial study of possible game prototypes reasonable for a Master thesis, qualitative methods using critical self-reflection as the first order of assessment seemed more appropriate and sensible than constructing an evaluation with children, given that there was little knowledge about educational games and dyslexia evident in the literature. An initial gathering of data through self-assessment seemed to be a good first step towards a larger undertaking involving under-age participants.



# *Results and Observations*

## *Introduction*

This section of the exegesis will discuss the results that were found in the projects and observations that were made.

## *Results*

The results that were found throughout the project were that interactive learning gaming applications could benefit students with Dyslexia because of the visual and interactive elements of the project. This result had been found from exploring other similar research articles like "Changing the Game: What Happens When Video Games Enter the Classroom?" by Kurt Squire (2005) which examines what the implications are of games entering the classroom for learning purposes. More results came through from the methods used throughout the research with action research and critical self-reflection. These results showed the correct format of how the game should be for the student with Dyslexia to learn the proper skills that are needed in the classroom. From my own self-reflection, I was able to know what games showed the most improvement from going through them and playing to see what knowledge was gained. I was able to recall the words visually and interactively from having to see them, then in some games, type them out. This was the same outcome for the games that involved mathematics and numbers. From having my own experience with Dyslexia as a child under the age of ten, the main struggle was being able to visualise a word or equation and then to recall the answer. These minigames showed that they could be a learning tool for a student to be able to create that pathway in their mind to connect the words or numbers visually and interactively to be able to work out the answer and furthermore gain the skill in that particular subject.

## *Observations*

Throughout my research, I found some interesting observations that I came across. When creating the minigames for the application, I wanted to get the target audience being the students that have Dyslexia excited about playing a game and not to focus so much on the learning part of the application. When playing the games, for example, the quiz game, I was more interested in trying to get the answer correct and winning the prizes rather than actually learning what the answer to each question was. However, when I went back to play the game again, the images of what the answers were from the last time I played were recalled in my head, and I was able to answer the question with no hesitation. With this being said, I am much older than my target audience but nevertheless, I do have Dyslexia and even now I struggle to recall words or answers that I have studied but when I had a visual or interactive way of learning it I was able to remember this knowledge that was needed to answer the question. This was an interesting observation and crucial to my results of what I observed throughout this project. Being able to recall answers from the minigames is a vital part of what I want the minigames to achieve for their target audience. This means that the player is not only playing an entertaining and stimulating game, they are also gaining the skills that are needed for their academics.

I also discovered the difference between typing out words and reading them when it comes to recalling knowledge and learning. In the majority of cases, students study by reading through notes that have been taken or texts to do with the subject that they need the theory on. In this case of a child that has Dyslexia, learning from a textbook can be difficult and disheartening. This can then lead to the student not wanting to bother with learning because they feel as though they are "not smart enough" when this is not the case at all. In the game I created called falling words, The words fall down the screen, and you have to type them out before they reach the bottom otherwise, game over. This shows the word to the user and then makes the user look at the keyboard at each letter to then type out what the word is. This is not only interactive but also a visual trigger for the user, which helps train their brain into knowing how to spell certain words. I observed this from using the application myself whilst creating the prototype. When choosing the right words to feature in the game that I had researched for a child of the ages five to seven, I added in words that I struggled to spell at my age now and then played the game to test it. After a couple of rounds of the game as the words started to repeat themselves, I found myself spelling the words at a faster pace each time and then when turning away

from the game I was able to spell the word with no issues on a piece of paper. This observation shows that when using your brains best learning pathways, for example, for a child with Dyslexia this is usually visual and kinaesthetic, you can learn the skills that are needed instead of trying to learn it the textbook way. This is why students who have Dyslexia would benefit from having the option of a different learning tool like this project.



Fig. 5 – Falling words game in play on application

# *Discussion and Conclusion*

## *Findings*

While this thesis being a midway point for a more extensive application and research, it provides some initial data and information for the research topic and for future researchers to use and answer questions that they may have.

From the action research and the critical self-reflection, it showed that having prototypes for the minigames showed a wide range of different ways that games can be made using different subjects to be able to pick up skills for a child that has Dyslexia. These then being narrowed down to specific subjects like spelling, reading, mathematics and learning nouns, which is the main subjects in schools at the ages of five to nine. Finding the correct method to what needs to go into each minigame was vital to the process and key to make sure that the student will learn from the game skills that are relevant in their classrooms as well as have a fun experience playing. The critical self-reflection showed that using my experience with not having a learning tool or a different method of learning for my academic work, pushed the application in the right way knowing what needed to be in it for it to work and be successful and not just being a fun game.

To summarise, from all data that was collected through the methodologies and the overall outcome of the research and the application itself, it showed that having an interactive visual application in the classroom would help students that have Dyslexia but would need to be put through a more extensive process of qualitative data to give an exact answer to the question. With that being said, it gave some findings to sub-questions of the research question which can be used in future situations for either further research or pushing forward with the project into the schooling curriculum in New Zealand.

## *Positives and Negatives*

The positives of researching this topic were creating an application that was needed when I was at school to be able to push my skills further when I was not able to follow the standard schooling curriculum. Being able to create an application that students with Dyslexia can use that benefits their skills for school makes the whole project worthwhile. Another positive is in the action research, designing the different prototypes for the minigames and being able to narrow down exactly what was needed in the games for them to be adequate to a student with Dyslexia that is under the age of ten.

This answered a lot of sub-research questions like what subjects are complicated for students with Dyslexia and what games will they benefit from playing the most that have a learning sequence in them.

The negatives of the research were the time restraints and limitations on what was achievable throughout the project. If I had time to further the scoring and the levels in the game, this might have created even more of a motivation for students to play. Creating different levels for the age range will be a crucial part in the next step in this research project.

### *What's to come in the future*

For the future of this interactive application for Dyslexia, I would love to expand on the minigames of the project and create more in-depth games which have more levels. For example, for the falling words game, to add more levels where the falling sequence of the words are faster each time a new level is played to give the user more of the gaming experience of being pushed mentally and having to pick up what the words are and spell them faster which will be great for their academic skills. I would also add a feature to this particular game where the teacher or adult that gives the child the application to use can add what words they want the child to learn that will feature in the game. At this point you can only add the words that appear on the screen through the hard coding of the application which is not accessible to the user. Having this feature on the game will be a great accessory for classrooms because most primary schools have spelling tests each week, this would then give the student the option to learn these spelling words through the application.

Putting in a more extensive scoring system would also be a significant advantage to this application. Because of the time limit that was given for this research, only a few of the minigames will provide you with a final score for what you have achieved in that game. I did this because I wanted to focus on the game itself and what skills you were learning from the game as well as it being a fun experience rather than just focusing on what score you get in the end. Over I do believe a scoring system is a good motivator for children to want to achieve further the next time that they are playing the game, which then will push their learning skills further.

I would have also liked to elaborate on the age range for the application. When you first start the game, you are asked what age you are, which then takes you through to the games menu for that age group. In this project, each door leads you to the same game difficulty level for all ages from five to nine.

Because of the time restraint, I was not able to create different levels of each minigame. I chose not to do this at this time because of knowing how much time I would have to be able to make each minigame to the level that I wanted it to be at and I did not want to rush this process. I thought it would be smarter to put the majority of my time into creating each minigame and keeping it at one difficulty level. I want to create the different difficulty levels for each age in the future for this application because some students at the ages of seven to nine, may find some of the games too easy, for example, the spelling. With that being said, each student that has Dyslexia has their own time on how fast they learn and should have the option of what level of difficulty for their skills.

Overall I would like to push the game into schools and see how it would run in a school environment in the classroom. Understanding how students use the application in the classroom and the results of it being in schools for an extended amount of time will be great for my future research to be able to see the results in a long term environment.

## *Conclusion*

In conclusion, my overall project was successful in what I wanted to achieve and is a step in the right direction of what should be used in classrooms for students with Dyslexia all over New Zealand. What I have created and my findings from this research have shown that this will benefit those students who need an extra learning tool to help with achieving the skills they need in those early years of learning. This thesis will help with future work for other researchers that are looking into similar research topics to show that using an interactive digital application in the classroom will be favourable to the students and that there does not have to be just one option of learning in the classroom especially for those with Dyslexia.



Fig. 6 – Main screen on application

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